

ESSAY

John Adams, Esq. 23rd March, 1844
TOUCHING THE

Adams 8. 67

Gravitation, or Non-gravitation

Richd. OF Randall
FLUID BODIES,

And

The Reasons thereof.



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*Concerning Gravitation of
Fluids upon Subjected
Bodies.*

CHAP. I.

The Introduction.



Have considered the noble Problem touching the Gravitation or Non-gravitation of Fluids upon the Bodies subjected to them: And of those several Solutions and Suppositions touching the same, given by the great Wits of latter Ages, which I shall in their due place, more particularly examine. B And

And I must needs commend the Industrie of this latter Age, in the inventing and exhibiting of very choice Experiments, as in relation to some other Philosophical Essays, so in particular, touching this Phenomenon of the *Gravitation or Non-gravitation of Fluids*.

But yet I must further add, that though their Experiments herein have been searched out, and formed with great Ingenuity, Industry, Curiosity and Expence; yet their Solutions of them, and the Suppositions and Reasons whereunto they have reduced them, have been (in my understanding) very unsatisfactory and inevident, if not wholly untrue and inexplicable,

And the reasons hereof seem to be principally these, *viz.* 1. That men have pre-ingaged themselves and their judgments in the assertion

on

on and maintainance of certain preconceived Hypotheses and Principles which they have invented, and are therefore extreamly addicted to, and unwilling to hear or receive any thing that may render their Labour herein vain and fruitless. And upon that account; have, not without much partiality, misapplied and misappropriated their Experiments and the Solutions of them, in favour of such Hypotheses as they have once invented or entertained, and with too much prejudice, reject any other Solutions, that may either overthrow, or at least not gratify such preconceived suppositions.

2. That men have not strictly enough considered of the Nature of Gravitations, and the Reason thereof. 3. That they have not enough taken into consideration those several accidental (as I may

call them) Interventions that abate, impede, advance, or direct the Gravitation of Bodies, though in themselves heavy, and tending to the Centre.

I do not intend to make a full Tract concerning Gravity or Gravitation; those that mind to trouble themselves therein, may at their leisure consult those Excellent Men that have written at large of this subject, as *Archimedes de insidentibus humido*. *Mersenius*, and *Stevinus* their Hydrostaticks; and although I cannot subscribe to all that the two latter have written in this subject, yet I must needs say, that I think little of moment hath been added to their Principles and Demonstrations by later Writers, only some new Experiments have been added by later Writers, bottom'd upon the Doctrin and Experiments of these Ancients.

I shall therefore direct all I have to say principally to this one matter or point, namely, the Gravitation or non-Gravitation of Fluids upon subjected Bodies, and the degrees and reasons of this *Phenomenon*.

And though it may possibly happen, that what I say herein may as little satisfy others, as their suppositions have satisfied me. And though my Explications of my thoughts herein, and the application of my Experiments thereunto may not be so clear and well worded as others of this Subject have been, yet I have this Apology for these defects; 1. That what I now write, though it hath been long upon my thoughts, was written *raptim* and hastily. 2. That I do not know that the Path I walk herein was ever before troden by any else. 3. It is but an Essay, and

took not up many hours in writing, and will take up much less in reading thereof.

And this I premise, not to arrogate singularity to my self, or to please my self in being the first inventor of this Explication; for possibly it may fall out, that it may bescarce worth the owning, when well examined by better Judgments, and possibly I my self may retract some things in it, upon better reason discovered: Yea, and possibly it may fall out, that some others have had a more early conception of it than my self, and may have dressed it in better order; and indeed it would be some confirmation to me, if it were so, though I have not yet known or heard of any such Anticipation.

I have seen many men very confident in the suppositions which they have found out; and yet upon

on full examination, their mistakes have been discovered : And although I think that I have laid down true suppositions, yet I will not be over-confident of them; for I may be over partial to myself, as I find others are to themselves and their suppositions; and it is not the confidence of the Author, but the Evidence of Reason, that prevails with sober men; and therefore I do propound them but as Essays, and submit them to further examination.

And the reason why I offer it to the publick view is, that better Judgments than my own may consider it; and though possibly they may not in all things approve it, or the manner of its Explication, yet they may by this opportunity, either improve it if they allow it, or make some useful superstructions upon it, for the farther disco-

very of this noble Problem; as
 Arithmeticians do by the Rule
 of False Position, make true Con-
 clusions, or at least may desert the
 vanity of this or any other opini-
 ons formerly offered touching the
 Solution of this *quesitum*, and offer
 better.

CHAP.

CHAP. II.

*Of Gravity and Gravitation,
and the true Reason of the
latter.*

GRAVITY it self seems to be an
Intrinfecal quality of Bodies,
whereby they tend downwards to,
or towards the Centre of the Earth.

I am not here to trouble my self
with these Philosophical Questions,
whether there be any other
Centre of Gravity than the Centre
of the Earth for weighty Bodies?
Nor what is the prime cause
of descent of heavy Bodies; whether
any Magnetical quality in
the Earth, or any forcible extrinfecal
Impression by the Motion
of the Heavens, or heavenly
Bodies, or that Circumpulsion of
other Bodies, that some have imagined,

gined, or any Intrinsic form of the heavy Bodies themselves, which is analogical to a vital principle, exerts this power. But it serves my turn at this time to call it an Intrinsic Quality of heavy Bodies. Gravitation is either Motion it self, or the *conatus* or *nifus ad motum*; and therefore it is (that according to that *linea directionis*, whereby, or according to which the Motion of Bodies are directed) not improper to say, that according to that Line of Direction, these Bodies do *gravitare*; and although ordinarily the Line of Directions of heavy Bodies, naturally is towards the Centre of the Earth in a perpendicular descent, which is the ordinary motion of Gravitation, and is greater or lesser according to the strength, weakness, or allay of this *nifus* or *conatus*: Yet it is not altogether incongruous

ous to say, that every thing that hath a *nisus* or *conatus ad motum*, doth in some sort Gravitare according to the Degree and Line of such Direction; and thus Fluids, though the primitive Line of the Direction of their Gravitation, may be perpendicular, yet Fluids have for the most part a natural Direction or Gravitation otherways, and some Fluids may have an Accidental Gravitation otherways. For instance, Water, though it have its primitive Line of Direction of its motion downward to the Centre, yet it hath Lines of Direction of its Motion otherways, as Laterally, or *per declivem*, and in some instances *per ascensum*, (whereof hereafter,) and consequently Gravitates every of those ways. For, as I said before, Gravitation is nothing else but Motion, or at least *conatus* or *nisus ad motum*. And

And therefore it is no real incongruity to say, that Fire or Gunpowder doth Gravitate in its Lines of Ascension or Expansion; that the Bullet, when shot upright, doth Gravitate *ascendendo*; when it is shot level it Gravitates *horizontally*, as long as that force prevails against its natural motion of Descent. For as to this purpose, Gravitation is nothing else but *motus*, or *nisus ad motum secundum in lineam Directionis ejusdem*.

Or And therefore it is, that when a weight of 10 or 20 l. is in the Scale *A*, and nothing in the Scale *B*, a Percussion with a Hand or Hammer in the Scale *B*, that moves the Scale *A* with its weight from the Horizontal Plane, wherein it stands, is truly said *prægravitare* to the Weight and Scale at *A*.



CHAP. III

*Concerning the Gravitation of
Solid Bodies, and their parts.*

IT is most certain, that every Solid Body, separate from the Earth, hath an actual Pressure or Gravitation, or *conatus ad motum* towards the Centre of the Earth, as its proper Line of Direction; (I speak not here of the Centre of Gravity of the Bodies themselves, *de quo vide sis Galdinum Gondicburlum, & Stephinum.*) Yea, if a Body be a Fluid Body, yet if it be severed from a Body of its own nature by a Vessel containing it, this Fluid Body in this consistency, obtains the natural rule and reason of a Solid Body, consisting of the Water and the Vessel containing it. As, for instance,

instance ; Water in a Pail or Bucket, as so stated, hath in it the nature of a Solid Body, and the Gravitation thereof is perpendicular to the Centre, which is its proper Line of Direction. And so Air included in a Bladder, though it swims in Water, yet doth Gravitate in some measure as other Solid Bodies do, and descends naturally to this Centre: yea a portion of Water by it self, being poured out of a Vessel from the top of a Tower or Steeple, hath its Line of Direction through the Air to the Centre, and will follow and Gravitate in that Line of perpendicular Descent. For though it be a Fluid Body in it self, yet relatively to the Air, being a lighter Body, through which it moves, it is in the nature of a Solid Body ; and yet in a great Descent the Acceleration of its motion, and the renitence of the Air will break
it

it into Drops or Dew, before it comes to the bottom in a great Descent.

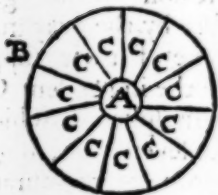
But though Solid Bodies do actually Gravitate, yet if they be continued, the parts thereof do not Gravitate one upon another, because mutually and mechanically sustained one by another, and in a state of Continuity: as a Bowl of Ebony that may weigh 10l, yet the upper Parts or Quarters thereof, whiles in Continuity, do not gravitate upon the lower; for if a hole were bored through the Bowl, yet the upper parts thereof would not gravitate upon the Cavity, for the reason before given.

And therefore the vast body of the Earth doth not gravitate upon its own Centre, because though all the parts thereof are perchance not simply continued as a Stone or piece of Wood; yet partly by their
mu-

mutual Compression one to another, and partly by the Intervention of the cement of Water, they are *quasi unum continuum*.

Again, if we should suppose that the vast body of the Earth were divided into several solid inverted Cones or Pyramids, and that the Centre of the Earth were a lesser Globe of soft Wax or Quick-silver, or other soft Matter, suppose a Mile in Diameter; and that each Cone or Pyramid, having a part of the acute end cut off, to be contiguous to this Globe of Wax; yet it were impossible that they should press or gravitate upon that Globe of Wax, because they would be each supported one by another, as will appear by the following Figure.

A



A the Globe of Wax in the middle of the Earth, *B* the Earth, *ccc* the several divided inverted Cones. For the upper Base of every Cone being larger than the acute part thereof, every Cone will be supported by his fellow without any gravitation upon the Globe, as *A*,

Yea, and it would fall out to be in the same manner, though we should suppose that the Globe of the Earth, which some have supposed to be 7000 Miles Diameter, should be but 1000 Miles in Earth, and the other 6000 Miles to be a Globe of Water, or some fluid Body,

for the reason before given.

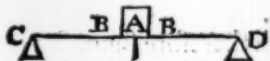
And this by the way may shew the mistake of their supposition that think the impendent Column of the Atmosphere, which they think to be seven Miles high, is a bare Column commensurate in its top and bottom, for it cannot be so, but at the most is an inverted Cone or *Pyramis*, considerably wider at seven Miles distance then it is at the Earth: which if considered, would trouble their Explication of the *Torricellian* Experiment, upon an account of the actual Gravitation of a Column of Air.

CHAP.

CHAP. IV.

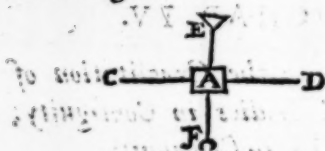
*Concerning the Gravitation of
Solid Bodies in Contiguity,
and not in Continuity.*

THE laws of Statiques do infallibly demonstrate, that the weight *A* incumbent upon the staff *B*, which at both extremities is supported by *C* and *D*, that *C* bears but one half of the weight *A*, and *D* the other half.



And consequently if there were another Staff set on cross from *E* to *F* of the same length, each Supporter

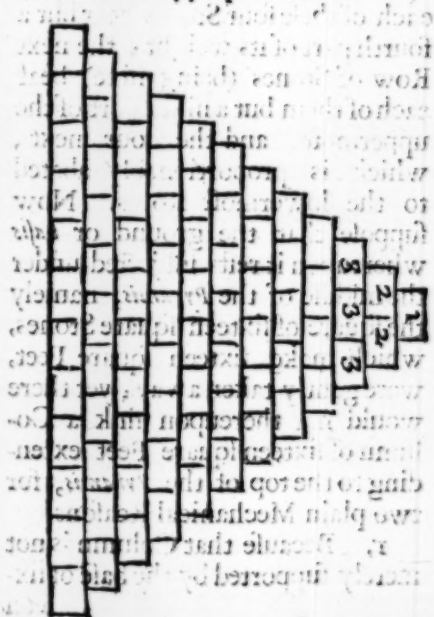
ter would bear but a fourth part of the Weight.



This being premised, I shall now consider the Gravitation of Solids not united and cemented together, either by Contunity of parts, or that which may be equivalent, Lime, Cement, or Morter, as in Brick-wals or Houses, but of such Solids as are united onely by Contiguity.

I will therefore suppose a *Pyramis* (or if you will a Pillar or Wall, for it will come all to one pass) having a foundation of twelve Stones, every way a Foot square, and piled up one upon another, breaking off joint according to Art of Masonry, but

but without Cement or Mortar;
 so that it will be twelve Foot square
 at the Base, according to this Fi-
 gure, and consequently the Area at
 the Base be 144 square Feet.



In this Figure these things are observable. The upper Stone marked (1) is supported by the four next Stones upon which it is bottomed, and each of these four Stones bear but a fourth part of its weight, the next Row of Stones (being nine) bear each of them but a ninth part of the uppermost, and the four next, which is proportionably abated to the lowermost Rows. Now suppose that the ground or *basis* whereupon it rests subjected under the middle of the *Pyramis*, namely the square of sixteen square Stones, which make sixteen square Feet, were gently taken away, yet there would not thereupon sink a Column of sixteen square Feet extending to the top of the *Pyramis*, for two plain Mechanical Reasons.

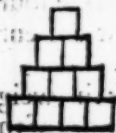
1. Because that Column is not merely supported by the base of sixteen

teen square Feet, but by the residue of the whole Pile; and it would stand like an Arch over that Cavity, which would happen upon the removal of these fourteen Stones, and those that are entirely supported by them.

2. Because the weight & the renitence of the rest of the Pile would keep up the *Pyramis*, if it had a sufficient weight by the residue of the Pile to bear one against another.

And so the residue of the *Pyramis* would stand without any Gravitation upon that Cavity; which would be left by the subsiding of those sixteen Stones, and those that are meerly supported on them, without any actual Gravitation upon that Cavity that is left, but onely upon the rest of the Base of the *Pyramide*; onely those Stones that were entirely supported by the sixteen subsiding Stones would

sink with it, and leave a Cavity like an Arch, maintained by the rest of the *Pyramis*, according to this ensuing Figure,



supposed to be the empty place of those sixteen subsiding stones, with those entirely supported by them, viz. nine, four, and one. And this Instance I have given of square Stones, to explain the reason of the thing: for it will hold in smaller and more irregular bodies.

Suppose there were a laying of a Floor of grains of Wheat, in a Floor of about 42 Foot circumference, and place an Egg, nay an Egg-shell, or Glas bubble perforated, that there may be the less pretence of resistance by its plenitude
of

of Air; let this Egg-shell or Bubble be placed in the middle of this Floor, that it may not be injured meerly by the hardness of the floor, then gently cover it with more Wheat of about a Foot deep, then pour upon it 20 or 40 Bushels of Wheat, that the Egg-shell or Bubble may lie above ten Foot under the top of the Heap; yet this Egg-shell or Bubble shall not be broken; and yet take a Glass or wooden hollow Cylinder, commensurate in base to the Egg-shell or Bubble, and four Foot long, stopped at the bottom, and lay it gently upon the Egg-shell or Bubble, it shall with its weight crush it to pieces.

And the reason is,

1. Because that every subjected grain of Wheat bears two, three, or four above it, and so the Egg-shell is not pressed with the weight of a whole Cylinder of Wheat of
ten

ten Foot in height, and proportionable in the base to the extension of the Egg-shell, but at the most with a small little Cone of Wheat, perchance not two Inches high, so that the Egg-shell and its little Cap or Cone of Wheat stands as under an Arch, supported by the rest of the Grains in the whole Heap.

2. Although the Grains of Wheat are of visible and considerable bulk, yet the position of the Heap of Wheat directs every Grain of Wheat poured upon the Heap accidentally to a lateral pressure *per declivē*, which refracts their perpendicular Gravitation. But of this more particularly and evidently, when we come to the Gravitation of Fluids.

And in conformity to these, or one of these Reasons, I took a Cylinder of Deal boards nailed together, and open at both ends, of about

two

two Foot long, and six Inches square in the concave Diam. and took two halves of an Egg-shell, emptied, and clapped them together, which would not sustain half a Pound weight put upon them, without a total crushing of them.

This Egg-shell I laid in a little bed of *Calice* Sand, and then putting my hollow Cylinder upon it, and poured into it gently *Gallice* Sand, till I had filled my Cylinder to the top, which contained about four Pound weight of Sand, and that very dry, and then upon the Sand I placed about six or seven pound weight of Lead, and carefully laying down my Cylinder of Sand, I found yet my Egg-shell in the same state as at first, without the least bruising, yea and lifting up the Cylinder of Sand, I found it so compacted, that it would not wholly go out, but remained suspended in the

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the body of the Cylinder, which I attributed, and (as I think) truly to the lateral pressure of the Sand upon the sides of the Vessel, where by these minute Particles were driven to lean one against another so hard, that they retain'd a kind of Solidity by this renitence.

And I think in this Experiment I have no need to have recourse to an Intelligent Hylarchical principle that suspended the Sand from Gravitation; nor to that other difficult Solution from the Texture of the subjected bodies; but merely to those two formerly mentioned, viz.

1. That each Particle of Sand was sustained mechanically the incumbent Particles, and left my Egg bottom shell as it were under an Arch, being pressed not with a Cylinder of Sand proportionable to its base, but at most with a small Cap or Conchoid of Sand, that did not considerably gravitate upon it.

ch I 2. That though the Sand is no
 truly fluid body, yet the smallness of its
 and Corpuscles had an accidental late-
 reral Direction *per declivē* against the
 sides of the Vessel, which lateral
 Direction refracted the perpendi-
 cular Gravitation of the Sand, as
 will be shewn more, when we
 come to consider of the Gravitati-
 on of Fluids, which may be illustra-
 ted by this Instance.

And because I proposed to profe-
 cute this Tryal farther, I made an
 Experiment by a heavier body,
 namely Leaden Hail-shot.

I took a Cylinder of Latten
 Sandware, about two Inches in Diame-
 ter, and 10 Inches deep, open at
 both ends, which held about six
 Pound of Shot. I placed it close to
 a Table, and filled it, and then gent-
 ly taking it from the Table, the
 Shot subsiding expanded into a
 compass of a Foot Diameter.

I then took the end of an Egg-shell, compressible with less than a Pound weight, placed it in a little Box that was receptible within the cavity of the Cylinder, and filled it up round with Shot, that it might not receive injury by the fall of the Shot through the Cylinder, and then clapping the Cylinder upon it, filled it up with about six Pound of Shot; but upon the opening of it the Egg-shell was not damnified.

Then I tried it by an Insect, namely putting in a Beetle into the box, and covering him with Shot, so that the fall of Shot from a higher place might not damnifie him; then putting my Cylinder over the box, filled it up with six Pound of Leaden Shot, and then opening it, I found my Beetle as lively as before, yet a weight of Lead in one solid body, commensurate to the base of the
the

the Beetle would have crushed him to pieces.

So that the Non-gravitation of these small bodies of Sand, Grannet, and Shot, may sufficiently prepare our minds to apprehend one of the reasons of Non-gravitation of Fluids, which though fluid, yet are not disjoined as in those former Instances, but a continued body, and therefore the upper Particles thereof more capable of support from those subjected Particles.

CHAP.

CHAP. V.

*Concerning the Gravitation of
Fluids upon subjected Bo-
dies, and first of the Gravi-
tation of Water.*

SOME things must be premised,
before I come to the main
matter I intend herein.

1. That it is certain Water
hath an intrinsecal Gravity of its
own, as it is a heavy body.

2. And consequently, if Water
be considered separate from Water,
as for the purpose when it is put
into a Vessel, as a Pail, Bucket, and
hollow Cube, or Globe, the Water
and the Vessel wherein it is making
now one body, doth actually gravi-
tate, and hath only one Direction
of

of its *motus* or *conatus ad motum*, as other solid bodies have, namely perpendicular to the Centre of the Earth, which is the Line and Term of its Motion. So that some have by computation estimated that a Cubique Foot of Water weighs about 65 Pound; for here the Water is not considered as a fluid Element, but is reduced into the nature of a solid heavy body, by the Vessel wherein it is contained and included, which together with it makes up one body, and consequently governed by the rules of Gravitation incident to solid bodies, *viz.* to descend perpendicularly. Therefore what I am now to treat of is touching the gravitation of Water, as it is in its own consistency a fluid body; and herein farther these things are to be admitted:

1. That the gravitation of the fluid water is all one, whether it be

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ini

in the great vessel of the Sea or Ocean, or in any other artificial and smaller vessel, as a Tub, Trough, or Cistern, I mean as to the main question; though there may be some various accidental differences in respect of the strength, weight, or consistence of the waters themselves; therefore the same reason will be of the Gravitation or Non-gravitation of Water upon a subjected body, whether it be in the Sea or in a Tub.

2. That without all question, when Water hath its passage out of a Vessel upon or through a lighter *medium* than it self, it doth actually gravitate; as if a hole be made in the bottome of a Tub, it doth gravitate upon that hole.

I shall not in this place dispute, whether Water in its fluid consistency hath not some degree of gravitation; for it hath been experimented

mented by many, that a Tube of Quicksilver inverted into a vessel of restagnant Quicksilver immersed into Water, hath some Indication of the gravitation of Water, by the ascending of the Quicksilver into the Tube, the deeper it is immersed in the water: and there may be reason for it, 1. In respect of the interspersions in the water of divers terrestrial Particles, or *granula arena*, that are in their own nature heavier than the water; which is visible to the Eye in great Rivers, and much more in the Sea. 2. There may possibly be supposed a small Cap or Cone of water, that may be impendent upon the subjected body, that may indure some inconsiderable and scarce perceptible gravitation. [*Vide quae dicta sunt in fine Capitis 9.*]

But that this gravitation is in any degree proportionable to the

column of Water, impending upon the subjected body, with a base answerable to it; or indeed that it is any considerable pressure in the hundredth degree of such a proportion, is most certainly untrue.

And if I should call hereunto the attestation of divers, the Experiment of the Tadpoles and Fishes, as well swimming in a great Profundity of water as in a small, nay in a vessel of water compress'd as much as possibly may be with a Rammer; these and infinite Instances more would make it beyond contradiction, that such pressure or gravitation is not at all considerable, though some it may be.

And now my business is to examine the reason of this *Phenomenon*, namely why the water in the Sea or in a Bucket doth not gravitate in proportion answerable to its intrinsic Gravity, or in proportion

portion to a column of water, proportioned in base to the breadth of the subjected body.

CHAP. VI.

*Concerning the Reasons assigned
by others for the Non-gravi-
tation of fluid Water upon
subjected Bodies.*

THough some contend for some gravitation of water, yet it is certain, that fluid water doth not gravitate upon subjected bodies in that prodigious proportion of weight, that a column of water commensurate in base to the subjected bodies, and extending from them to the *superficies* of the water,; for if it should, it must crush the subjected bodies to pieces,
or

or at least wholly suspend their motion, for such a column of water, ten or twelve Fathom deep, impending upon a Diver, would amount to some Tuns of Water, which if separated in a vessel, would crush all his bones. But the Reasons that Learned men have assigned for this matter, as they differ among themselves, so they are in themselves very inevident and unsatisfactory, which, as near as I apprehend them, are much of what follows.

Stevinus gives this reason, that the pressure of water is equal every way, upward, downward, and laterally, and therefore the body of a man being thus equally compressed every way by the circumjacent water, hath his continuity preserved, and is not crushed by the impending weight of water, neither feels it, but is kept in an equal state and *Æquilibrium*.

But

But the truth is, this leaves the difficulty equal, if not worse than before; for an equal pressure of every side would crush his bowels, and brest, and ribs into an intolerable condition, and yet leave him to the severity of the perpendicular weight nevertheless.

Des Cartes gives this obscure and scarce intelligible Reason of it, which, as near as I apprehend him, is thus; Because when the man sinks into the water, as he descends, the subjacent water takes the room that his body left. But this salves not the difficulty of the Non-gravitation of the column of water, when once got above him.

Mersenius salves it, as he thinks, by the Doctrine of *Archimedes*, *de insidentibus humido*, namely that any given portion of water suffers no weight by the superior portion of water, because they are all of one

equal Gravity, and therefore every part of water sits quiet in any *situs* given, without Gravitation or being gravitated by any portion of it self.

And that Bodies heavier than water, (as the body of man is) loseth so much of their natural weight, when in the water, by the weight of such a quantity of water, as is commensurate to the bulk of that heavier body; so that it hath no more than what it exceeds the weight of the like quantity of water. As if the body of a man weighs 200 Pound, and the like quantity of water would weigh 150 Pound, the body of a man would weigh in water but 50 Pound, and upon this account a Diver might easily emerge out of the water, for he carries with him but 50 Pound weight; and the intermediate water not being gravitated by the
por-

portion of water above it, doth not consequently gravitate upon the man, unless some accident intervene, as where the body of the man stops a Leak or a Hole in that vessel wherein he is.

But this, though it assert the thing, namely that Water gravitates not upon Water, or upon any body of an intrinsic Gravity equal to Water, yet it leaves us in the dark, touching the reason of the Non-gravitation of Water upon the subjacent Water, or any body of an equal intrinsic Gravity with it; since he seems to agree, that the whole Water gravitates upon the Fund or *basis* of the Vessel, for some have thought it impossible that the whole body of the water should gravitate upon the *basis*, unless every part gravitate upon what is intermediate between it and the *basis*. Though by the way this is not confessed.

sequential, for a piece of Lead of a Pound weight doth actually gravitate upon the Scale, and yet the upper part of that piece of Lead doth not gravitate upon the subjacent parts thereof, so long as they are one continued body; and so it may be, and probably is in fluid bodies, while they have their continuity; for a Bucket of water is as much one continued body, as a Bucket of Pitch or Wax, till it be actually divided; but of this hereafter.

A later Author, not content with these Explications, hath supposed a middle intelligent nature between Almighty God, and Matter, or Bodies, which he calls *principium hylarchicum*, under whose regiment those various appearances of Nature are managed, of which we cannot find any ready sufficient natural Solution. And although the end of this learned Author

thor be good, namely to convince Atheists, and such as deny the Existence of separate or Spiritual Intelligences, yet me thinks the *medium*, at least as to the particular in hand, is not so suitable. The most important and surest Truths in the world never receive so much detriment by the Arguments and Sophistry of Opponents, as they do by those Arguments in their favour which have improper *mediums* to support their Conclusions, or such as are capable of other Solutions.

Most certainly the Ever-glorious and most Wise God is the Author of Nature, and of all the Laws thereof; they are his Institutions by which he orders and regulates the Motions and Appearances in Nature. And he supports them as an Universal Cause, by the constant influence of his Power and Goodness; and all their Appearances are
ne-

nevertheless ordinarily regular according to his instituted Laws of Nature. And as it far more advanceth the honour and skill of an excellent Artift, that hath so framed and ordered an *Automaton*, that it may be regularly guided to its end, according to the design of the Artift, without the immediate hand or identifiſical act of the Artift to guide every motion: ſo it far more advanceth the glory of the Divine Wiſdom, in that he hath ſetled ſuch a regular order in things of Nature, that may regularly conduct them to their deſigned end; then if the Glorious God, or any intelligent Power by him ſubſtituted, ſhould by immediate and identical interpoſition produce every *Phænomenon* in Nature, ſaving nevertheless to him his Power and Pleaſure *pro arbitrio*, and upon ſuch occasions as he thinks fit to interpoſe

pose his own immediate power, either by the determination of his own will immediately, or by the ministration of Angels or Intelligences, to advance, correct, or alter his standing Laws in particular cases and emergencies.

But yet farther, it seems to me that the particular instance of the Non-gravitation of water deserves no more a recourse to an Hylarchical Agent, than the Instance above given of the Non-gravitation of a heap of Sand, or Corn, or Shot; for I think the Solution of one and the other are rational, and much of the same kind, as to the Mechanical part hereof.

But yet farther, a very Late and Excellent man hath endeavoured to give a Solution of this *phenomenon*, which seems less satisfactory than any of the rest; for when he hath abundantly demonstrated by his

his exact Experiments that Animals do not suffer so great a pressure by the incumbent column of water, that doth considerably if at all impede their Animal motion, he attributes it to the Frame and Texture of their Bodies, the ordering of their Bones, Muscles, and other parts; and this I confess gratifieth the preconceived *hypothesis* of the Gravitation of the supposed column of water, (as likewise of that of Air, in the Solution of the *Torricellian* Experiment.) But it seems to me, that this Solution favours more of a Miracle than the former supposition of the Hylarchical Principle: that a Flownder should at Land be pressed to death by the weight of a gallon of water in a Bucket laid upon him; and yet should not be damnaified by the weight of two, or three, or ten Tun of water in the bottom of the Sea.

yet

yet he sustains it without detriment or impediment of his life or agitation : which I say were miraculous, if those Tuns of water did actually gravitate in that measure. Therefore I think there had need be some other Solutions than those thought upon, if we can hit upon them.

CHAP.

CHAP. VII.

*Concerning the most probable
solution of the Phenomenon
of the Non-Gravitation of
Water in its fluid consistence.*

IN matters controverted, though it be more easie to find faults with the suppositions of others, than to substitute such in their room as may be less capable of Exception; yet it is but just that (if it be possible) for every one that excepts against anothers supposition, should exhibit one of his own, that so he may run the same tryal with others, as others have done with him. And therefore in the former Chapter having (as near as I can understand them) propounded the
so-

Solutions of other men, and laid them by, as seeming to me either inevident, or not giving a reasonable account of the Probleme, I shall now exhibit my own Conjecture of the Reason of this Appearance in Nature, wishing it no better success with others, than it deserves.

I have before premised, that
 1. this question must not be understood of a vessel of water, as the *continens* and *res contenta* make but one common Body, for so it is but in nature of a solid and not of a fluid body, and there is in that respect no more consideration to be had of its fluidity, than if the water in the vessel had been congeled into a whole Kegg of Ice; for the Kegg of Ice and the Water in the Bucket, together with the Bucket containing it; or the Water in the Bladder, together with the Bladder containing it, descend by one
 E simple

simple line of Gravitation, perpendicularly from its centre of Gravity towards the centre of the Earth: but the question is touching the gravitation of the water in its fluid consistence, though contained in the Ocean, or in a Tub or Bucket. 2. That I do not in this place contend against all Gravitation of water, for possibly there may be some little allowed it, as unto Air, and especially by reason of the interspersions in the water (as likewise in the Air) of some small Atomes or Particles of terrestrial Matter, which may be heterogeneous to the nature of water as such, and as those Particles are in their gravity heavier than water, so they may accidentally cause a greater gravitation in the Particles of some water more than of other, as hath been before said.

But that which I contend for in this

this place, is first, that the gravitation of water in its fluid consistency, whether in the Sea or in a Bucket, if any at all, yet is so inconsiderable, that it doth not considerably press upon subjected bodies, nor incommode Animals that live therein at any profundity, and not in the thousandth part in actual gravitation proportionable to the weight of a Column of water commensurate in base to the subjected body, and extending from the same to the *superficies* of the water. Secondly, to assign some reason of such Non-gravitation, and why it is not, no nor indeed can be.

The former of these is in effect confessed by all impartial Writers, and evident to every days experience. The latter therefore, namely the reason thereof, are the subject of this Chapters inquiry.

And I think the reasons of this

Non-gravitation of the Particles of water upon such subjected bodies, are especially two. The first is Mechanical, from the structure of the fluid water; and the second is meerly natural, from the nature of Fluids. Touching the former of these, the Mechanical Solution of this Problem, this hath been in effect given before, in the Non-gravitation of the parts of solid bodies while in Continuity, which it is plain though they all together gravitate upon the Scale, yet one part doth not gravitate upon another: And water, though a fluid body, yet hath its continuity, which is undivided, and so gravitates not upon its own parts, nor upon any body within it of equal or greater weight than it self. But 2. admit, that water, in respect of its fluidity, should most participate of the nature

ture or reason of solute and separable bodies, that are only contiguous; yet even in those solute bodies, as Sand, Granes, Shot, every Monad of such solute bodies gives support to the superjacent Particles, though not united into one *continuum*, as in the instances of a Pyramid of square Stones, a heap of Wheat, or of *Callice* Sand; wherein a kind of Arch is made over the subjected bodies, that they by no means sustain the whole weight of the incumbent column, proportionate to the base of the body included.

But in case of the body of water, the same advantage is infinitely more improveable for the ease and security of the subjacent bodies, whether animate or not. For although I shall not take advantage of the imaginary configuration of the Particles of water invented by *des Cartes*, who supposeth them to

belike small oblong filaments or fibres, not much unlike little Grigs or Eels, which would easily make a consistency, that like an Arch would protect and cover the subjacent body. Nevertheless I shall say this, that the union of its parts are much closer than that of the Monads of *Callice* sand, for the water is *quid continuum*, though *fluidum*; & therefore as the parts of one continued solid body do not gravitate upon the other parts, but only upon the common base of the whole body; so the parts of water do not gravitate upon themselves, nor upon any particular base less than their own base; but one part sustains the other without any gravitation; as the Arch of a well fringed Vault, doth not press upon the subjected Vault, but each part is sustained by the other, and the whole by those walls from whence the

the Ribs of the Arch are drawn. A very little industrious trial of the suspension of Sand in a Tube framed for that purpose, will make the Instance more intelligible, than words or writing can do it.

It may possibly be true, that a more broad body, heavier than so much quantity of water, may have a greater gravitation of water upon it than a narrower, because the arch that is made over it by the water, is greater than that Arch that is made over the narrower body. For instance, let us suppose that in the bottom of a Bucket of water, three foot deep, and one foot in the circumference, there be placed an Ebony rundle, of one Inch thick, and eight Inches Diameter, and in the bottom of the like Bucket there be placed a rundle of Ebony of four Inches Diameter, and of such a thickness, as may make the

weight of it equal to the weight of the greater rundle, as in the subjected Figures.



I say it may fall out, that the water may more gravitate upon the greater Rundle, than upon the lesser, because that small Cone of water that is incumbent upon the greater, which hath the larger base, makes a larger Conical body of water upon that which hath the larger *basis*, than that which hath the narrower. This may be easily tried by a pair of Scales, industriously ordered for such an Experiment. But however that fall out, it is most evident, that the whole weight of the column of water, commensurate to the base of either Rundle, and

and extending it self to the *superficies* of the water, doth not in its full weight gravitate upon either, unless we suppose a hole in the bottom of the Vessel under either Rundle, and then indeed the water will gravitate upon the Rundle, because it gravitates upon the hole.

But if the subjected body be lighter than the like quantity of water, commensurable to its bulk, then it is true the water will undermine that lighter body, and carry it to the *superficies*, notwithstanding the superimpendent Cone or Column of water: but this is not to my present purpose to explicate, and therefore I leave it.

CHAP. VIII.

The second and principle Reason of the Non-gravitation of Water upon it self, or a subjected Animal, or other body.

I Come now to the second principal Reason of this Non-gravitation of Water, either upon its inferior parts, or upon any subjected Animal or Body, either heavier or equal in weight to the like bulk of Water; for if it be lighter, it will swim, as hath been said. And this I take to be the true natural specific Reason of the Non-gravitation of Fluids; though the former, namely the Mechanical Reason before given is not wholly useless, but contributes its part to it.

And

And here I must premise what I before said of that actual gravitation, *viz.* that it is either Motion, or *conatus* or *nifus ad motum*.

And therefore let the body be never so intrinsically heavy, yet if even by accident (much more if by the natural consistency thereof) that *nifus* or *conatus* be suspended or corrected, the Gravitation abateth. For instance, it is most certain that the body of the Earth is intrinsically heavy, and the heaviest of all Elements that we know of; yet whether we suppose it to be the Centre of the World, or that the Sun is that Centre, and the Earth in its *magnus Orbis* moves about it, yet it hath no Gravitation to incline it to change its place, or its circular motion; and the reason is, because it hath no *nifus* or *conatus* to any other position or place then what it hath.

Again

Again, in matters artificial it is plain, that a Pound of Lead hath its natural motion by a perpendicular direction and line to the centre of the Earth; and this is the true cause of its Gravitation upon my Hand, namely its *nifus ad motum*; and as any body hath the greater *nifus* or *conatus* than another, so it hath the greater actual Gravitation, as Gold more than Quicksilver, that than Lead, that than Tin, quantity for quantity.

But if I take a pair of Scales, and in one Scale put a pound of Lead, and in another half a Pound, I check and abate its *conatus*, and consequently its gravitation, and it hath but half the vigor of gravitation as it had before; and if I counterpoise it in the other Scale with a full equal weight, I suspend totally its gravitation, and it shall ascend or descend with a small advantage of
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a grane added to the opposite Scale, or to this, and still the reason is the same, the *nifus*, or *conatus ad motum*, and consequently the actual gravitation depending upon it, is checked by the Counter-motion of the opposite Scale. That therefore which I must perform in the application of this Reason, consists of these Parts or Propositions.

1. The first Proposition, which is this; That which hath several Directions or Lines of its *conatus ad motum*, must needs have several Directions of its Gravitation.

2. That body which hath several lines or directions of its Gravitation variously directed, cannot entirely gravitate in one line, or by one direction.

3. That which doth not gravitate by one line or direction, but variously, it must necessarily follow, that every tendency, line, or direction

ction of its gravitation doth correct and refract the force of its other gravitations according to its other tendencies and directions.

4. That Fluids, and particularly that of Water and Air, have several lines of its direction of gravitation, and therefore necessarily one must be refracted, impeded, and abated by the other.

5. And consequently, the direction of its perpendicular or lateral gravitation are corrected, and very neer wholly suspended by the other tendencies or directions of its motion. And although in order of reasoning I should begin with the more general Propositions; yet because they will be the best evidenced by beginning with the enquiry into the various directions of the motion, *conatus* and *nifus* of Fluids, I shall invert the order of that Ratiocination, and begin at the latter end,

end, namely the various Directions of the *conatus* or *nifus ad motum* of Fluids.

That there is a motion, and *conatus ad motum* in water, as a heavy body, in a perpendicular line of direction toward the centre, all do agree, and it need not be questioned, for it seems it is the primitive *conatus* of this as of all heavy bodies, and is an effect of its intrinsick gravity. But besides this primitive motion as a heavy Body, it hath divers other motions and directions as a fluid body, and those naturally belonging to it in that consistency. For instance,

1. It hath within the compass of its own *superficies* a lateral motion parallel to the Horizon: which appears by the immersing of a Tube shut at both ends, and placed horizontally below the *superficies* of the water, and then suddenly
un-

unstopping one end, the water will as nimbly move into that Tube, as if it stood perpendicular to the Horizon.

2. Again, within the compass of its own *superficies* it hath a motion, and consequently a *conatus ad motum*, and consequently a gravitation directly vertical; as if a Tube stopt at the lower end, and immersed into the water, and then the lower end artificially unstopped, the water will arise in that Tube to the level of the *superficies* of the stagnant water, and drive out the Air that was in it before.

3. Again, it is certain, that the water in any vessel hath *conatus ad motum per declivē*, in all points between a line parallel to the Horizon, and the line of its perpendicular gravitation, according to this rude Diagram in the vessel of water *A*.

And



And although for descriptions sake I make these lines of direction *per declivē*, to be from the centre of the *superficies* of the water, yet I think it improper, and indeed impossible to shew or define, from what point of the water this *conatus ad motum per declivē* begins. Nay farther, it seems evident, that water being a *homogeneous* body, every assignable Particle of water hath this direction of *descensus per declivē*, as all other directions incident to its fluid nature, as well as the o-

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ther motions or *conatus* above specified.

And that the water hath these lateral pressures, and *conatus ad motum per declivē*, is evident to sense; for, take a Barrel set upon his base, and fill'd with water or any other liquor, it will with almost an equal force gravitate upon the sides of the vessel, as well as upon the fund or base, and break out the sides if it be not well guarded with Hoops or other strictures.

Now to apply this position to the former Propositions, I say this various motion and *conatus ad motum* of Fluids, causeth several kinds and *species* of lines and directions of their Gravitation, some directly descending, some directly ascending, some Horizontally lateral, some *per declivē*, or medial between a line parallel to the Horizon, and perpendicular thereunto.

And

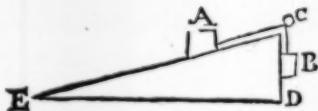
And consequently in the very same fluid body every different direction (whether lateral *per declive*, or perpendicular) of its Gravitation is corrected, abated, and refracted by the other; and it is impossible it should have its full swinge of motion any one way, or by any one line, since it hath its considerable motion or *conatus ad motum*, the same moment by another line, either contrary or extremely different from the other, *omnibus intentus minor est ad singula*. And consequently the gravitation of Fluids, whether lateral, or perpendicular, or *per declive*, *sive per modum linea subtenfa*, is abated, corrected, and refracted, by the various lines of its tendency: for it is impossible that the same body can at the same time with its full swinge be carried to any one point, which at the same time hath very

neer an equal *conatus ad motum* to a various point, and by a various line of Direction; or that that Fluid should *totis viribus* be directed in its motion or *conatus* thereunto towards the centre, which at the same time is directed laterally, or towards the North in its lateral motion, or *motus per declive*, which at the same time hath a direction or tendency towards the South-East or West, or any other point of the Compass, either laterally or *per declive*.

It is true, that possibly that kind of line of Direction in a perpendicular descent may be considerably stronger and more efficacious, and consequently the gravitation that way stronger than in any one other line of direction of its gravitation, because there contributes to that motion, not only the nature of Water as a fluid body, but also as a heavy

heavy body, which always taketh the shortest line of direction to the centre, which is the perpendicular.

And hence it is, that if there be an Engine consisting of a Base parallel to the Horizon, and a perpendicular upon that Base, and a Subtense or decline *superficies* from that perpendicular to the Horizon, as in the subjected Figure.



The weight A upon the Subtense doth counterpoise to the weight B in a reversed proportion, answerable to the length of the lines CE and CD . So that if the perpendicular CD be half the length of the Subtense CE , the same weight
upon

upon the line CD gravitates double to the same weight A , upon the line CE : because it hath the most expedite and short way to the centre by the perpendicular CD ; and the other by CE is longer, and refracted, and broken by the inclination and distance CE . But on the other side, if the line of perpendicular descent of the Fluid be compared with all those various and many lines of its other direction, when the centre at least hath any considerable depth, the perpendicular motion of its gravitation as a heavy body, is either altogether or very neer altogether corrected, abated, and refracted by its other motions or *conatus ad motum*, or gravitation as a fluid body, since there are as many or more other *species* of lines directing its *conatus ad motum* in other lines, as there are of its perpendicular descent.

And

And è *converso*, all the several lateral lines, or lines of Declivity of its tendency *ad motum* are so far corrected and refracted by its perpendicular, and other *conatus ad motum*, that they are as in the former instance of the two equiponderating Ballances, rendred in a manner *in equilibrio*, and all of its several lines of Gravitation and tendencies thereunto, are in a very great degree suspended and refracted one by another.

And surely this consequence is abundantly evidenced by the instances before given, *Chap. 4.* in the Column of *Callice* Sand: which is much more confirmed in water. For the Monads of *Callice* Sand are actually divided one from another, but the Particles of water are conjoined in one *Continuum*: the motion of *Callice* Sand *per declive* is not simply natural, but accidental in

respect of the position of those parts upon which it falls, which because they one hinder another from the next and shortest way to the centre of their motion, by a straight line, therefore move *per declive* as well as they may. But Fluids have all those varieties of tendencies incident to their nature; yet it is apparent beyond all contradiction, that this accidental tendency of the motion of Sands *per declive*, doth break the perpendicular gravitation, and makes it not to gravitate upon the most fragile subjected body in its full weight.

But I shall yet farther adventure to add one farther Explication and Enforcement of this Supposition: it is asserted by some, that a Foot square or Cubique Foot of water, weighs about 65 pounds, which I have not Experimented, and therefore cannot assert;
But

But I will suppose (as making best for the Explication of what I intend) it weighs but twelve pound, and this is the entire perpendicular weight of this portion of water; for *ex supposito* it weighs no more, being put into a Bucket, & weighed in a pair of Scales, with due allowance for the weight of the vessel; and it is impossible it should be more in the whole than the weight supposed.

But it is apparent, that the direction of this weight of twelve Pound, allowed to the water while it is in the Bucket, is not only perpendicular upon the Base, but laterally upon the Sides of the vessel that contains it: and every side of this Cube of water hath as many kinds for its Direction of descent lateral or *per declive*, as the Base hath for its perpendicular descent.

And yet here is but entirely one
twelve

twelve Pound weight of water, that must serve as the common stock of all its Pressures, *viz.* lateral *per declive*, or perpendicular, and must be distributed to all these lines as water from one common Cistern, through so many Pipes to serve all these Gravitations, or *conatus ad motum*; for it hath not in all above twelve Pound weight to serve all these *conatus* or Gravitations.

The consequence whereof is of necessity, that this common stock of intrinsic weight of twelve pound, belonging to all this portion of water, is neither intirely allowed as the supply or portion of the perpendicular weight or gravitation, nor entirely allowed to the lateral gravitation, or the *nifus ad motum per declive*, nor to any one kind of Line of either of these *conatus*; but is indifferently, or very near in-

indifferently communicated to every line of its *conatus ad motum*, whether lineally descending, or collaterally, or *per declive*, and the common portion of twelve Pound weight is very neer equally divided to every line of Direction in the water, which are as many as there be divisible parts in the lateral or subjected base of the vessel of water.

And by this distribution it must needs fall out, that the weight of twelve Pound of water is infinitely distributed according to various direction, and no one line can pretend to the entire gravitation of that twelve pound of water, no nor to the thousandth part thereof, considering its various distribution.

And now if any one shall ask, if the water in the Bucket hath not one entire gravitation towards the Centre in the perpendicular Line,
but

but hath its weight thus distributed to several lines of direction; how it comes to pass that the whole Bucket of water weighs perpendicularly twelve Pound, and that weight is not broken by the lateral pressure of the water.

The Answer is plain, and hath been sufficiently insinuated before.

The water in the Bucket is as fluid a body as so much water in the Ocean, and hath the same kind of motion, and *conatus ad motum*, as well collaterally as by direct descent, as is incident to its nature, though it receive an obstruction in that motion, by the strong sides and contignation of the Bucket. But the Bucket of water is now become as one solid body, and gravitates according to a solid body, *viz. per lineam descensionis*, and not as a Fluid *quoquo versum*: and though the fluid water within the Bucket
press

press upon all parts of the Bucket, according to its natural and various tendency, yet it goes no farther, nor do the sides of the Bucket press upon the ambient Air, or *medium*, being sufficiently secured by its strength and firmness, and not yielding to the *conatus* or *nisus* of the included water.

Many other Instances and Experiments might be added for the evincing of the truth of this Supposition, but if I make myself intelligible to the Reader, these are sufficient to explicate what I mean, and his own observation will furnish him with Experiments either to confute, or to confirm what I have said.

And thus far touching the non-gravitation of Water, & the reason thereof; which may be (as I think) applicable to all other fluid bodies, as Oyl, yea Quick-silver it self,

self, at least in a great degree, and by analogy of Reason, though I have not had opportunity to Experiment it.

CHAP. IX.

Certain Consequences or Consequences, drawn from what hath been before said.

FROM what hath been before expressed in the two former Chapters, these things seem naturally to follow.

1. That the upper parts of a fluid body doth not gravitate upon the lower parts of that fluid body.
2. That if any body of equal weight with the Fluid be within the extent of the fluid body, the fluid body doth not gravitate upon it, nor it upon the subjected fluid body,

dy, but every part holds its station.

3. That a fluid body contained within a solid vessel, doth not with its full weight gravitate upon the base of that vessel that contains it, as the whole body of the Sea, or of the water in a Bucket, doth not gravitate with its full weight upon the entire base that sustains it; and this is in respect of the natural consistency and frame of Fluids, not purely upon the account of Mechanical Sustentation, which must be agreed somewhere to gravitate, though not upon all parts, as hath been shewn.

4. Though it were granted that the entire bulk and weight of the water in the Sea or a Vessel might gravitate upon the entire base, (which yet is not admitted) yet the parallel parts of water do not entirely gravitate upon a part
pro-

proportionable to them. For instance, suppose a Cube of water in a vessel of nine Inches square; if we should suppose the whole Cube should gravitate upon the base, yet the column of three Inches square in the middle of the Cube would not gravitate upon three Inches square in the middle of the base of the Cube, even for the Mechanical reason above given.

5. That consequently, no body heavier than water in the base or Fund, doth sustain a weight of water proportionable to such a column of water as is in the base and top, commensurate to the amplitude of the body in the fund or bottom.

I shall add this unpolished Experiment for the conclusion of this *Chap.* namely, I made an Experiment touching the weight of a piece of Lead, in several depths of water ;
I

I cannot build much upon it, because my opportunities for it were not exact, nor such as others may have, yet I shall offer it: others may make, or possibly have made it with more exactness.

I took a flat round Cake of Lead, of four Inches Diameter, and making four holes in the four quarters of it, I suspended it parallel to the Horizon upon a Packthrid of five Foot long, and hanged it to the end of a ballance like the Dish or Scale, and counterpoised the Lead and Packthrid by a weight imposed in the other Scale, the Lead and Packthrid *in arido* weighed ten Ounces, and as much as the Dish wherein the ten ounces were placed, which possibly might be about two ounces more, in all about 12 Ounces.

In a vessel above four Foot deep in water, I immersed the Lead four

G

Foot

Foot deep in water, and then (as it needs must by the grossness of the *medium*) it lost part of its gravitation, and weighed only eight Ounces $\frac{1}{2} \frac{1}{4}$, besides the weight of the opposite Scale. Then taking up the string shorter, I immerled it only in a Foot depth of water, but yet it gain'd no more weight that I could perceive, but weighed as before one Ounce $\frac{1}{2} \frac{1}{4}$.

But indeed immersing it onely in one Inch of water below the *superficies*, it increased its weight near $\frac{1}{8}$ of of an Ounce, for the Lead weighed one Ounce $\frac{1}{2} \frac{1}{4} \frac{1}{8}$ of an Ounce, or very near thereabouts, besides the weight of the opposite Scale or Dish.

By this rude Experiment it seems the Column of four Foot of water, gravitated no more than one Foot of water; for if it had any accession of weight, it was not perceptible, yet

yet (according to *Stevinus* calculation, in his 4th book of his Hydrostaticks, (which yet I do not altogether allow) that a Cubique Foot of water weighs 65 Pound,) the proportion of the Column of 4 foot amounts to about 567 square Inches, which is about 8 pound; but the Column of one Foot is but 144 Inches, which is but about two pound weight of water. I do not trouble my self with curiosity in calculation; but it sufficeth, to give some account of the Imperceptibleness, or at least Inconsiderableness of the difference of the gravitations of Water in various Depths.

CHAP. X.

Concerning the gravitation of the Air.

I Do not intend here to make any large discourse upon this point,

because indeed it deserves a larger Examination than this portion of Paper that remains will afford, to unrivet that Opinion touching the Gravitation of free Air, with which many have pleased themselves, and thereby indeavoured to reduce the solutions of Problems and Appearances in Nature, but are therein as I think deceived.

That the Air may have Gravitation, it being secluded from the ambient Air by a Vessel (as well as Water) as in a Bladder, none that I know do much deny.

That the interspersions in the Air of *halitus terrestres*, & *vapores aquosi*, may have and hath some Gravitation, more than what belongs to pure Air, I shall not question. But that the Air, yea or Atmosphere hath that prodigious gravitation, that the late Masters of Experiments have attributed to it, is

is I suppose a mistaken Assertion. As, for instance, that upon a restagnant vessel of three Inches diameter, the weight of the incumbent column of Air, actually gravitating upon that restagnant vessel of Quick-silver, and commensurate to the base thereof, and extending from the same to the upper surface of the Atmosphere, which they suppose to be 6 or 7 Miles) should counterpoise a suspended column of Quick-silver, which may be 2, 3, 4, or 5 Pounds, according to the bigness of the Tube. This, I say, seems to me but an Imagination, and impossible to be true, and would choak all Animals on the Earth in two minutes, if it were so.

For the plain truth is, the Air, no nor yet the Atmosphere, notwithstanding its interspersions, hath no considerable gravitation upon subjected bodies. And the
reason

reason is in effect before given, in the case of the water, and its gravitation, but with much greater advantage applicable to the Air.

1. The body of the Air is not only *quid continuum*, but the parts of it are so contiguated, like a Net, that each part supports another; and its as impossible that one part should gravitate considerably upon any subjected body, as the Arch of *westminster* Abby should gravitate upon the people in the Church.

2. The *conatus ad motum*, and consequently the gravitation of the Air is *quicquid versum*, viz. *sursum*, *deorsum*, *dextrorsum*, *sinistrorsum*, &c. it will come down my chimney, and in at my door, and up my stairs, and these various *conatus ad motum* of the Air and of its Particles, do necessarily refract any gravitation that it may imaginably have *per lineam perpendicularem descensus*, and renders

renders it *equable* and disingaged from any one line of presence.

And by this *conatus ad motum*, I mean not that Imaginary *Elaterium* which some have called in to the Aid of their solution of the *Torricellian* Experiment, which I must needs say needs more help than one: for though Air violently compress'd, as in Wind-guns, hath its *conatus* of restitution to its natural staple, and being expanded by Rarification, hath its natural motion or *conatus* of restitution to its due consistency, as appears in the *Torricellian*, and divers other Experiments; yet the great *Elaterium* of the Air in its natural consistence, called in by some to help at a lift, as it hath little evidence, so it contributes less to the solution.

Indeed it hath a Fluidity greater than Water, and therefore is moveable to all places for its reception.

It

It is compressible, which water is not ; but for any *Elatarium*, or such considerable Expansion of it self, as to offer any force to other bodies, seems unwarranted by reason or Experience, or common sense, unless where by violence or accident compressed or expanded beyond its natural size.

But I do not at present pursue this matter to all its Refuges, it requires more time and Paper, and will exceed the bounds of my intended Pamphlet ; and besides , the Discussion foregoing, touching the reason of *Non-gravitation of Water* , renders that concerning *Non-gravitation of Air* easily intelligible, and applicable to it, with much greater advantage of reason and evidence.

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